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ART. I.—*Medical and Surgical Notes of Campaigns in the War with Mexico, during the years 1845, 1846, 1847, and 1848.* By JOHN B. PORTER, M. D., Surgeon U. S. Army.

In my former paper, some reasons were given for preferring the circular mode of amputating limbs to the flap operation, especially in military surgery. They are the following:—

The wound in the circular is not so extensive as in the flap operation; and in a bad atmosphere, or in an insalubrious country, this is a great advantage.

The bone is sooner and more easily sawed through, the arteries are more easily secured, and the stump is more quickly and easily dressed in the circular than in the flap operation.

A better stump is made in the circular than in the flap operation. This is the strongest argument in favour of the circular mode of operating.

Only a few cases of amputation were given in the former paper, which were those having something peculiar in the circumstances attending them. Common cases are of no interest, and were not included.

Since amputation by the circular incisions is not the fashionable mode, it may be well to cite the opinions of a few of the most experienced authors on the subject, especially of those who have seen service in the field.

Baron Larrey says:—

“I have had opportunities of comparing the two methods; and the uniform success which has followed the circular amputation has convinced me that it possesses more advantages than the operation with the flaps, as still recommended by some modern practitioners.”—*Memoirs*, vol. ii. p. 102.

Mr. Guthrie says:—

“I always divide the skin and fascia by the first circular incision down to the muscles; they will then retract with very little assistance, from the point of

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the knife at particular spots of adherence, instead of the useless and painful dissection of the skin from the fascia, which formerly took place."—*Clin. Lect.* p. 6, 1836.

"In primary amputations, or in the natural state of parts, the loose attachment of the cellular membrane to the fascia and to the muscles beneath admits of much retraction of the integuments; and when the first incision is made through the fascia, they retract considerably; which is greatly increased if the assistant grasps the limb with both hands previously to the incision being made, and pulls the integuments as much upwards as possible, putting the skin to be divided on the stretch, and rendering its division more easy to the surgeon and less painful to the patient. If the limb be also firmly grasped below, and the integuments made tense downwards, the division of the skin will be more readily effected, and so much of the integuments will be saved in consequence of the retraction upwards, that it will not be necessary to dissect them back in the manner recommended in many surgical works. It will be sufficient to separate the threads of fascia adhering below with the point of the same knife, to obtain an ample covering for the stump, without putting the patient to the torture of having his skin pinched and dissected back for the space of a couple of inches, and for four or five minutes. Bronfield and Alanson inveigh against this practice; and military surgeons during the last war proved it to be so unnecessary that it is now acknowledged in general to be so by those who formerly recommended it; but in the adoption of it, they do not at all seem to be aware that the fascia and integuments should be divided by the same incision, when the whole will retract much further than the skin and cellular membrane could do if the fascia remained to be divided by the second incision. I consider this simple direction to be of great importance in the saving of time and pain to the patient, whilst it adds to the facility with which the operation is accomplished, and prevents the lodgment of matter between the skin and the muscles, which frequently occurs in the usual method of doing this part of the operation."—*On Gunshot Wounds*, p. 274.

But Mr. Guthrie, it appears, operated by both methods.

"If a cannon shot strike the back part of the thigh, and carry away the muscular part behind, and with it the great sciatic nerve, amputation is necessary, even if the bone be untouched; for, although the wound might in some measure heal, the motion of the leg would be lost, and it would become an insupportable burden to the patient. In this case, I would not perform the operation by the circular incision, but would preserve a flap from the fore part or sides, as I could get it to cover the bone, which should be short; I would then cut away the injured part, leaving a clear incised surface. The object to be gained by this kind of operation is to obtain a longer stump than could be made by the circular incision. \* \* \* But if the injury committed on the soft parts does not render this possible, or enable the surgeon to save a longer stump, the circular incision is to be preferred."—*Ibid.*, pp. 370, 371.

"The flap operation ought only to be done at the upper part of the thigh, is very similar to that proposed for the hip-joint, and is, in some instances, preferable to the circular incision, as it permits a longer stump to be saved, where the integuments are not sound in a circular direction."—*Ibid.*, p. 383.

"Amputation of the leg is performed in two ways: by the circular incision, and by the flap operation; the circular incision being most applicable to the fleshy part of the leg about the calf; the flap operation to the lower and tendinous part near the ankle, where sufficient integuments and muscle cannot be obtained to make a good cushion for the bones in the usual manner."—*Ibid.*, p. 400.

"Amputation of the arm by the common circular incision is to be practised only in the space between the lower edge of the insertion of the pectoralis major and the elbow-joint. More serious wounds may be inflicted in this space, however, and the arm be preserved, than in any other part of the extremities."—*Ibid.*, pp. 512, 513.

Mr. Guthrie is in favour of the flap in the lower part of the forearm, but

"when the operation is to be performed above the middle, it is best done by the circular incision."

Mr. Hennen says:—

"I have myself, on two late occasions, performed amputation of the thigh so very high up, nearly embracing the trochanter, and consequently the capsular ligament of the joint, that a very few strokes of the scalpel would have effected the dislocation; more especially, if the head and neck of the bone had been split to pieces, as they very often are. My incision was the common circular one; and I did not, as I once before had done, make the taking up of the femoral artery a necessary preliminary measure; I tied the arteries in succession as they were cut, an able assistant pressing on that in the groin."—p. 216.

"In commencing an amputation below a joint, and particularly in a large lower limb, I would recommend placing the right hand under the limb, and carrying it to some extent round, in the position meant to commence the incision, and then dropping the knife into the hand, instead of running the hand ready armed with the knife beneath the part."—p. 217.

"By cutting the first third, or nearly so, of the circle, principally with the heel of the knife, we shall always be enabled to complete the external incision with one sweep of the instrument, a matter of some relief to the patient in point of pain, and of increased facility to the operator, in forming a smooth even edged line."—p. 217.

"In the forearm almost every possible error of projecting bone, or insufficient covering, is effectually obviated by the flap operation."—p. 218.

I have amputated the forearm at all points by the circular method, and never found the least difficulty in making a good stump. It is an easy operation for the surgeon.

Mr. Hennen was generally in favour of the circular method, for he says, in addition to the above remarks on amputation of the large limbs:—

"In a small limb, I have repeatedly performed the operation with one sweep of the knife, cutting obliquely inwards and upwards, to the bone. The only objection that strikes me to operating in this mode is, that the arteries are sliced obliquely like a writing pen, instead of being fairly cut across, and that if this is not kept in remembrance, secondary hemorrhage may take place after the vigour of circulation is restored, in consequence of the whole circumference of the vessel not being included in the ligature."—p. 218.

The slicing of the arteries obliquely like a "writing pen," instead of fairly cutting them "across," is an objection to the flap operation. The subject was alluded to in my first paper.

S. Cooper says:—

"Amputation is performed in the continuity of a member, or at one of its articulations, each of which modes, however, cannot always be practised indifferently, the choice depending upon the situation, extent, and nature of the disease, or injury, for which the removal of the part becomes indispensable. In all amputations done at the joints, it is the general practice to make a flap for covering the end of the bone; but when the operation is performed at another part of the limb, it is frequently at the option of the surgeon, whether the method adopted be *amputation with a flap*, or *amputation by a circular incision*. In all common instances, the latter practice receives the approbation of many of the best modern surgeons; but there are particular cases, in which a deviation from this mode, in favour of the flap operation, is commendable and useful, as I shall hereafter notice." The notice is what follows: "The chief objections to the operation (by the flap), when proposed as the common method, arise from two considerations: first, its greater pain than that of the usual mode; secondly, its shortening the limb more than is necessary. Yet, all British surgeons agree that flap amputations are generally the best, when a limb is to

be taken off at a joint, and also in every instance in which the skin and soft parts are quite sound on one side of a member, while on the other they are diseased, or destroyed for a considerable extent, upwards. Here, amputating with a flap will be the means of preserving more of the limb than could be saved by the circular incision, and becomes praiseworthy on the very same principle which renders the latter method most eligible under ordinary circumstances."

Mr. Syme, when a follower of Mr. Liston, used the following language:—

"That the circular operation is tedious, every one will allow who reflects upon the multiplicity of its steps. First, there is the cautious circular incision of the skin; the change of knife; the dissection of the skin; its turning back; the change of knife; the adjustment of the assistant's fingers, that they may not be cut off by the relentless sweep which divides the muscles; the change of knife; the separation of the muscles from the bone; the division of the periosteum; the application of the retractors; and, lastly, the sawing of the bone."

These are formidable charges against the circular method of amputating. But, instead of the "cautious circular incision of the skin," the skin and fascia are to be boldly divided down to the muscles; little or no "dissection of the skin" is necessary; no "turning back" is required; nor is a change of knife thought of, excepting in peculiar circumstances. If the "assistant's fingers" are in the way, they deserve to be cut off; but this is a "game that two can play." Some years ago, I assisted an operator to amputate the thigh, by the flap operation, near the hip-joint. My part of the performance was to command the artery at the os pubis, which was effectually done; but the surgeon came near maiming me for life, and I begged him, in the name of a kind Providence, to spare my fingers, as they might be of use hereafter. This circumstance convinced me that an awkward operator can cut off fingers as well in the flap as in the circular method. The "separation of the muscles from the bone," if required, may be done with the amputating knife; the "division of the periosteum" may be made with the same knife; and the "sawing of the bone" is as necessary in the one operation as in the other.

But Mr. Syme speaks of the two methods (*Monthly Journ. of Med. Sci.*, Nov. 1846) very candidly, as follows:—

"Notwithstanding the share I took in introducing the flap operation, and the confident persuasion of its superiority formerly entertained, I have long felt occasion to point out some serious inconveniences apt to attend its performance; and I am now satisfied that there are circumstances in which the circular incision ought to be preferred."

After giving the arguments for and against each method of operation, Mr. Syme goes on to say:—

"In subjecting these various arguments, on both sides of the question, to the test of experience, it may be remarked that they are not all of equal value; some of them relating to matter of mere convenience, while others regard consequences of the most serious nature. The great questions at issue are, which operation least endangers the patient's life? and which affords the most comfortable stump? Now, every one who has witnessed the flap operation extensively and indiscriminately for amputation of the thigh, must have seen a large proportion of deaths, and in the event of recovery, not unfrequently a condition of the stump no less unsightly than inconvenient. Such are the undeniable facts, and their explanation presents little difficulty to any one who has had sufficient opportunity of observation.

"So far as the mere performance, or early consequences of the flap operation

are concerned, nothing can be more satisfactory. The incisions are executed almost instantaneously, and the whole process is completed with a degree of facility, dispatch, and ease to the patient that presents a remarkable contrast, when compared with the circular method.

"When the flaps are placed together, it seems as if nothing could prevent their perfect union, so as to effect a speedy cure, and afford a comfortable covering to the bone. In some cases these favourable anticipations are fully realized; but, though a good many days, and even one or two weeks, may elapse without making manifest the disappointment to be experienced, it much more frequently happens that the soft parts, however ample they may have appeared in the first instance, gradually contract and diminish, until care is required to keep their edges in apposition over the bone, which sometimes, notwithstanding every precaution, at length becomes denuded, and presenting itself to view, whether dead or living, proclaims the unavoidable misery of a sugar-loaf stump. This distressing result depends upon the vital contractility of the muscular tissue, which, continuing in operation so long as the cut surface is not prevented from yielding, by the formation of new adhesion, not only lessens the mass of flesh provided for covering the bone, but gradually retracts it together with the superficial integuments. The effect thus produced is favoured by the following circumstance. In the first place, by cutting the flaps of such moderate length that, when brought together, they merely meet without straining; secondly, by sawing the bone where it is exposed, by simply separating the flaps, instead of drawing the muscles back, so as to divide it at a considerably higher point; and thirdly, by performing the operation at the lower third of the thigh. Mr. Liston recommends amputating at the middle of the bone, upon the ground of thus forming a more convenient stump for the attachment of an artificial limb, than would result from operating at a lower point. For my own part, I have, during many years past, advised this, to prevent the great risk, or almost certainty of protrusion, to which the bone is exposed when divided at or near its lower third. But the flap operation being thus objectionable below the middle of the thigh, and even higher up, seldom in the end furnishing more than a covering of skin to the bone, it may be inquired, how far the circular method deserves adoption in amputation at the lower third?

"The true object of the circular incision is, to provide a covering of skin for the bone; and a great error has been committed by many, indeed almost all the would-be improvers of this operation, in directing their attention to modifying the division of the muscles, as if any form of their section could materially influence the result. All the attempts with this view have been directed so as in one way or other to give the cut surface of the muscles a conical form, evidently under the impression that they serve to assist in covering the bone. Now, it is quite clear that, if the ample masses of flesh afforded by the flap operation yield to the retractile agency of their tissue, the scanty portion obtained by any form of circular incision cannot have the slightest effect in improving the condition of the stump. These wrong-directed efforts would have done no harm, unless they had withdrawn attention from what was really required to render the result satisfactory. In this way, however, they have seriously opposed improvement, and in my own case, I confess, long prevented the truth from being distinctly seen.

"The perfect condition of the stump resulting from amputation at the ankle, where there is nothing but integument to protect the bone, led me to conclude that, if the circular operation could be performed with the certainty of providing such a covering, it might be employed with advantage in the lower third of the thigh; which, being the thinnest part of the limb, most readily admits of forming a stump composed merely of skin. There is, also, in operating here, plenty of room to apply the tourniquet without impeding the incisions or retraction of the muscles, and the size of the wound inflicted is, of course, much smaller than of an amputation at the middle of the thigh. In the course of the summer, I have performed the operation four times, on adult persons, with the effect of confirming the favourable expectations which the considerations just mentioned had led me to entertain; and I now feel warranted to advise that, whenever a case

requiring amputation of the thigh, admits of the limb being removed at its lower third, the circular method should be employed.

"The compress of the tourniquet should be applied over the artery close to the groin. Instead of the old-fashioned, concave-edged, thick-backed amputating knife, a middle-sized one of the kind employed for the flap operation will be found more convenient. The incision of the skin should be made as near the knee as possible, not in a circular direction, but so as to form two semilunar edges, which may meet together in a line from side to side, without projecting at the corners. The fascia should be divided along with the integuments, which are thus more easily retracted—not by dissecting and turning them back, but by steadily drawing them upwards, through means of the assistant's hands firmly clasping the limb. This should be done to the extent of at least two inches, or more, if the thigh is unusually thick. The muscles are then to be divided as high as they have been exposed, by a circular sweep of the knife, directly down to the bone, from which they must be separated and retracted with the utmost care. In ordinary circumstances, the retraction should not be less than two inches, and, before using the saw, the bone must be completely exposed by means of a cloth split up the middle, applied on each side of it, and forcibly held up.

"If due attention be paid to these directions, I feel confident that amputation by circular incision at the lower third of the thigh will afford satisfactory results; and should, therefore, be preferred to the flap operation at a higher part of the limb when the circumstances afford room for choice. Where it is necessary to amputate at or above the middle of the bone, there can be no question as to the propriety of operating by the flap method."

"Before arriving at the conclusion which has just been explained, I thought that amputation at the knee might be employed with advantage, as a substitute for the flap operation at the middle of the thigh; and my own opinion would still be so if this alternative afforded the only room for choice. I operated at the knee with complete success in three cases; two of which were diseases of the joint; and the other a recent injury from the leg having been torn off by machinery. But as the soft parts required to form the stump in this situation are apt to be so deranged in their texture as to delay, though not prevent recovery, and thus in some measure counterbalance the advantage of exposing cancellated instead of dense bone, together with the contents of its medullary cavity, I do not persist in advocating amputation at the knee, now when satisfied that the operation by the circular incision, if performed with due care on proper principles, may be employed at the lower third of the thigh safely and advantageously."

The long extracts from Mr. Syme's able paper are warranted by the importance of the subject, and they deserve serious consideration. The important questions are

1. Which operation least endangers the patient's life?
2. Which affords the most comfortable stump?

The contractility of the muscular tissue produces a bad stump in the flap operation, while the contractility has no effect in the circular method. Why is this? It is owing to the union of the skin, fascia, and muscular fibre in one mass in the flap operation, and to the separation of the skin and fascia from the muscle in the circular method. The contractility of the muscle separates the whole flap, skin, fascia, and muscle completely from the bone; while the muscular tissue in the circular mode may contract to such a degree as to allow the bone to project beyond it; but this is of little consequence, for the skin and fascia still form a covering. As Mr. Syme says: "The true object of the circular incision is to provide a covering of skin for the bone."

Let this be kept in view in amputation of the thigh; save plenty of skin and fascia together; cut the muscles high up, and directly down to the bone if you please; perhaps sever them somewhat from the bone with the point of the knife; and raise them well up with the retractor before sawing the bone. By attending to these particulars, with the grand object of the circular incision in view, it is scarcely probable that the bone will project in the progress of the case. The radical difference between the two operations consists in the formation of the covering for the bone, which is principally muscular in the true flap operation, producing inconveniences and serious consequences; while the flap or covering of the bone by the circular incision is formed principally of skin, cellular substance, and the fascia. To attain the object of throwing out the muscular tissue, so that its contractility can exert little or no influence on the covering of the bone, is worth all the trouble which the opponents of the circular incision bring so prominently forward, even to the repeated changes of the knife. This is the great distinction between the circular and the flap operations. In my first operation above the knee, I was greatly troubled about the result, fearing there was not sufficient muscle, though there was plenty of integument; but the result was highly favourable. Had I reflected on the subject, my mind would have been at ease, and at the present time I would throw all fears of a bad stump, ulceration, projection of bone, &c., to the winds.

Mr. Liston, however, does not deign to give a description of the circular method of amputation in his *Elements of Surgery*, notwithstanding the respectable names in its favour; but seems to consider his *dictum* fully sufficient to settle the question. Mr. Liston says:—

“Hitherto these general observations on amputation have regarded the flap operation only; the circular method has not been mentioned. The reason is, that the circular amputation has been, it is hoped, in a great measure abandoned in this country. And its inferiority to the method by flaps is so obvious and so generally acknowledged, that detail of the different steps of the operation is, I conceive, here altogether unnecessary. It is more tedious in performance, more painful to the patient, does not afford so good a covering for the end of the bone, and consequently not so convenient and useful a support for an artificial limb, and the cure of the wound is protracted. The stump is almost always conical, the end of the bone is, ultimately at least, covered only by integument, and from even very slight pressure this is apt to ulcerate; exfoliation of the bone follows to a greater or less extent, or unhealthy ulcer of the soft parts continues along with caries of the bone, and partial death of its surface; and at length it becomes necessary to either perform a second amputation, or to curtail the length of the bone. It may sometimes succeed tolerably well when there is but one bone; when there are two, it is altogether inadmissible. In very muscular limbs, when amputation is demanded on account of destruction of the bones and joints, with laceration of the soft parts, as when the patient is not required to have pressure made on the stump, it suits well to make the flap of integument only, and to cut the muscles short, as will be noticed more fully. The advocates for the circular amputation, my excellent friend, Sir George Ballingall and others, wish it to be believed (and this is their main argument), that the exposed surface of the flaps is much greater than that in their favourite method. Some of the philosophers of the modern Athens have been applied to, and have measured, it is said, the area of the one and the other, and given their verdict in favour of the roundabout incision.”

The advocates for the circular amputation may not wish to take anything on trust, not even the views of Mr. Liston; but it is to be hoped they are willing to permit every one to enjoy his own deliberately formed opinion. Fifty or one hundred years ago, some acknowledged leader might have dictated to the whole body of the profession; but those days have fortunately gone by. It is to be regretted that Mr. Liston did not remember this, and recollect that the time had passed when men and measures, if they did not square with the dictator's ideas, might be, in the classic language of Mr. John Hunter, easily "cracked like so many vermin as they come before me." In the present age the profession acknowledges no leader. *Nullius addictus jurare in verba magistri.*

Let us look at Chelius:—

"As regards the preference of the several modes of proceeding in amputation of the limb in their continuity, I must, according to my own experience, prefer amputation by the circular cut, and that method indeed, in which the skin is divided and drawn back, and at its edge the cut carried vertically through the muscles down to the bone, and then the muscles still remaining attached to the bone cut through still higher, and thus a conical surface of wound formed. The superior advantages ascribed to the flap operation, to wit, a better covering of the stump with muscle, more speedy union, and therewith a shortening of the cure, over the circular operation just recommended, are groundless. *In reference to the first point, Bruningshausen makes a remark which I have also observed, that the covering of the stump with muscle may indeed be effected at the moment of union and for some time, but that after a longer period the bone is merely covered with skin.*"

The italics are my own. At this point Mr. South remarks:—

[“This observation, as regards both flap and circular amputations, will be found confirmed by every one who examines a stump a sufficient length of time after its complete healing.”]

“On the other hand, after amputating the *thigh with merely saving skin, I have never seen protrusion of the bone.* But it must be held as an objection to flap operations that tying the vessels which are obliquely cut through, and often wounded in several places, is more difficult, and the number of vessels to be tied is always greater than with the circular cut, that the wound is larger, and therefore, if union do not take place, wasting suppuration is to be earlier feared. In other respects, I do not consider the dispute as to the preference of the circular or flap operation of so much consequence as many do, as I am convinced that the successful result depends not merely on the mode of operation, but on the manner of its performance, and especially on the proper conduct of the after treatment. The flap operation, however, must always be considered more suitable when the amputation is performed at the upper third of the thigh; when the limb cannot be brought into a proper posture for performing the circular cut, and when the destruction of the soft parts is such that by the flap considerable saving may be effected.”—South's *Chelius*, vol. iii. p. 651.

Mr. South remarks:—

“As regards these serious objections to circular operations, I must observe that, in the large hospital with which I am connected, for many years I scarcely ever witnessed the performance of any other than circular amputations, except on the forearm, and that the ugly consequences which Liston has detailed were of great rarity, and not, I believe, attributable to the mode of operation. Of late years, however, more flap operations have been performed among us than previously, and probably their relative number is now about the same. I have performed about an equal number of each, and the result has been so nearly the same that, in most cases, I hardly think one is to be preferred to the other.

The flap operations are more smart and showy in their performance, but in their result may be as untoward and unsatisfactory as circular operations have been stated to be."—South's *Chelius*, vol. iii, p. 553.

"At a meeting of the Reading Pathological Society, Mr. Bulley read a short paper on some of the disadvantages which he considered to attend the flap operation for amputation. He thought it was a much more painful operation than the circular one, and that, in the aggregate, it took a longer time in the performance. More painful from the greater extent of the integument divided, and from the oblique incision of the nerves; and longer in performance from the oblique section of the vessels, rendering them unable to collapse, and thus, with a greater difficulty in securing them, a greater number of arteries required ligature. An eminent surgeon in London had mentioned to him that he had been obliged to apply twenty-five ligatures after a flap operation in which there was reason to believe that, had the circular method been employed, three or four might have been sufficient."—1846.

Mr. Rutherford Alcock has found, with reference to the main question of comparative mortality, that his results are by a fraction disadvantageous to flap amputations. He is not, therefore, prepared to agree in what was said to be the growing opinion, that this operation would in time completely supersede the other.—1841.

Sir George Ballingall says:—

"I know of no comparative estimate of the results of amputations performed by the circular incision and by the double flap, which will enable us to decide their respective merits by the test of experience; but in instituting any comparison between these operations, one of the first circumstances which strikes a surgeon is the different extent of cut surface left by the one operation and by the other. It has long appeared to me that the difference in this respect is much greater than many surgeons are aware of; and I have often remarked that the extent of cut surface exposed by the double flap operation appeared to me nearly double that left by the circular incision. I was not, however, aware until very lately that in making this statement I was so near the truth."

"It is not, however, the extent of cut surface alone that seems to me an objection to the flap operation, but in proportion to the extent of this surface is the number of vessels requiring ligature; in amputation of the thigh, for instance, when the operation is undertaken for long-standing disease of the knee-joint, and performed very low down, we have the flaps, particularly the extreme points of them, often highly vascular; and it is no uncommon thing to find from eight to ten vessels requiring ligature, whereas half this number is the more usual proportion in the circular operation. It will be easily understood that a vessel which requires a ligature in the lower edge of the flap may, in its progress towards it, have given off several branches, each of them requiring the same security, and many or all of which would have been removed along with the distal part of the limb by the circular incision. It will also be understood that in operating by the double flap the blood-vessels are often cut obliquely; sometimes, indeed, they may be seen scooped like a writing pen; and although this may be of no great moment when these vessels are carefully and accurately secured with ligatures, yet this is obviously a division of the vessel unfavourable to its retraction and rapid closure; and if in consequence of the faintness of the patient, a vessel should not bleed, and not be secured at the time of the operation, it will be more liable to bleed afterwards when the patient rallies and the blood returns perhaps with increased impetus to the wounded point. In proof of this, I appeal to the observation of my colleagues here, where the flap operation has been almost exclusively performed for many years past. Hemorrhage perhaps scarcely coming under the usual description of secondary hemorrhage, but occurring a few hours after the patient is laid in bed, is an almost every-day occurrence; in fact, the practice of delaying the complete dressing of a stump for several hours after the operation has been advocated, in addition to other reasons, upon the ground of its affording a facility to meet

this sort of secondary hemorrhage. In one case I have seen nine vessels secured upon the table, and eleven afterwards; and in a very recent case, we had eight or nine vessels secured before the patient left the operating table, and the same number within an hour afterwards, in consequence of hemorrhage from the stump. A very striking illustration of the liability of flap operations to secondary hemorrhage has been mentioned to me by Mr. Alcock, who states that 'in two cases at Vittoria of double amputation, one leg in each was amputated by flap, and another by circular incision; from the former in both patients there was secondary hemorrhage, and from neither of the latter.'"

"The state of the nerves in flap operations is another most important consideration; the remark I have made as to the ramifications of the arteries will in some measure apply to the nerves, and we sometimes see large portions of nerves exposed upon the surface of the flap, or projecting loosely from it."

"The next point of view in which the two operations may be compared is the covering left for the extremity of the bone, and the favourable state of the parts for an accurate approximation, and speedy healing of the wounds. In both these respects the comparison is highly in favour of the flap operation, according to the views entertained, and the practice followed by the surgeons of this country; but should circumstances occur to prevent union by the first intention, it is obvious from what has been said that the flap operation leaves a larger quantity of suppurating surface. Facility and rapidity of execution are seldom a fair ground of preference for one operation over another; and can never be so when other important considerations are to be sacrificed to them; it is indeed possible to conceive cases, particularly in military or naval life, where, *ceteris paribus*, the saving of time may be an object; but the rapidity with which the flap operation can be executed has, I fear, been sometimes made a ground of preference where no such motive existed; and I cannot divest myself of the suspicion that the feeling of rivalry has in some measure led to the indiscriminate practice of flap operations. It is not every young surgeon who can stand by undisturbed and hear it said, and hear it repeated, that his colleague will amputate a limb in so many seconds, while he requires perhaps as many minutes. The flap operation is a seductive one, and I speak from my own experience when I say that it is an operation which one is unwilling to relinquish after having once experienced the comparative facility of its execution. It will be seen, however, that I am quite prepared to discriminate between those cases in which the flap is to be considered the preferable operation, and those in which the circular incision is the best. I may here state generally that in operations at the joints, the adoption of the flap operation is calculated to facilitate the disarticulation of the bone; and in coming to particulars I would specify the shoulder and hip-joints, the forearm, and the leg, as cases in which this operation is decidedly preferable; but I am by no means prepared to admit its exclusive advantages in operating on the arm, and still less in operating on the thigh. These seem to me the principal points of importance in a general comparison of the two operations."

The foregoing extracts must serve to convince the disciples of Mr. Liston that the "inferiority to the method by flaps" is not so "generally acknowledged" as the *Elements of Surgery* might lead us to suppose. Mr. Guthrie's description of his method of amputating in the Peninsula bears on the subject.

"1. I did not use a tourniquet, the screwing and unscrewing of which always create some difficulty and annoyance. I never do when I have good assistants, but you must have recourse to it when alone or when they are ignorant. A very moderate and simple pressure suffices to stop the flow of blood through the largest artery.

"2. I always divide the skin and fascia by the first circular incision down to the muscles; they will then retract with very little assistance from the point of the knife at particular spots of adherence, instead of the useless and painful dissection of the skin from the fascia, which formerly took place.

"3. You will find in books that, in dividing the muscles, you are to take particular care that you cut the long and unattached ones of a different length from those which are attached to the thigh bone, and each muscle according to its power of retraction; so that they must be cut long and short, and of different lengths, something like the parts composing the compensation pendulum of a clock. I have no objection to all this; but I never saw it done, and have long since given up all thoughts of doing it myself; and why? because I have seen scores of amputations done by all sorts of hackers, hewers, and bunglers, and I invariably found that no matter how they were hacked or hewed, whether the muscles were cut according to compensation principles or not, they always made capital stumps when another rule was observed, viz., to cut the bone, that is, to have it well covered by these same muscles and integuments. It is the golden rule of amputation, and the quicker you can do everything else and come to that, the better for your patient.

"4. Saw your bone perpendicularly, and not slantingly, which prevents its splintering."—*Clinical Lectures*, p. 6.

An operation performed in the manner above described can scarcely produce a bad stump. In the thigh, the integuments being well drawn up, let a rapid circular incision be carried down to the very muscle; let another sweep (the integuments being well drawn up) be carried down to the very lowest muscles; let another sweep (with the integuments and superficial muscles well drawn up) divide the deep-seated muscles down to the bone; and then let the divided parts be well drawn up by the retractor, and the bone sawed through in the manner stated by Mr. Guthrie, and a bad stump will rarely occur. It may be advisable, in fleshy parts like the thigh, to save plenty of muscle, as recommended by Mr. Guthrie; but, according to Syme, Chelius, and others, this is of little consequence, provided sufficient integument be preserved to cover the bone. Indeed, "the perfect condition of the stump resulting from amputation at the ankle, where there is nothing but integument to protect the bone, led me to conclude," says Mr. Syme, "that, if the circular operation could be performed with the certainty of providing such a covering, it might be employed with advantage in the lower third of the thigh; which being the thinnest part of the limb, most readily admits of forming a stump composed merely of skin." If there be not sufficient muscle in a limb to cover the bone, it is of little consequence.

In amputation of the leg, some surgeons, who are in favour of the circular method in all other limbs, prefer the flap operation. But the gastrocnemius is a powerful muscle, and by its contractility may give trouble in the course of cure. "So far as my own experience proves," says Mr. South, "flap operations, in the continuity of the bone, may be performed as successfully as circular operations on every limb but the leg, in which the calf muscles are so bulky that it is often difficult to get the skin well over them, if they be left, and I do not think the cure is so quick as with the circular. But if a skin flap be made, and the muscles cut through directly, I do not think more time is gained than by the circular operation. There is, however, a more serious objection to flap operation through the calf, in the greater frequency of after-bleeding; this has occurred to me two or three times, and the number of vessels I have had to take up, and the sloughy condition of the whole flap, and

its tedious union by granulation, have almost induced me to determine never to operate on the leg but with the circular."—iii. p. 654.

In the arm and forearm, the operation by the circular incision is very rapidly performed by one sweep of the knife down to the muscles, and another sweep to the bone. In the hand and foot, the flap operation is preferable, for the best of reasons—there is no muscular tissue in the flap to interfere with the cure. It is in principle, therefore, a circular operation. Major —, volunteers, was badly wounded in the hand at Monterey, on the morning of the 24th of September, 1846, after hostilities had ceased, by the accidental discharge of his own pistol. The index and part of its metacarpal bone, and the middle finger at the joint, were taken away by the flap operation, and the patient was cured in a surprisingly short period of time. He was never admitted into hospital, but came to me every day to have the wound attended to. One reason why operations on the hand are more successful than those on the foot is, that the patient is able to take regular and gentle exercise.

There are certain cases in which amputation by the flap is preferable to the circular method, forming the exceptions to the general rule in favour of the latter. They are,

1. Amputations at joints. 2. Near the hip-joint, in the upper extremity of the thigh. 3. When the limb cannot be brought into a proper posture for performing the circular cut (*Chelius*). 4. When the destruction of the soft parts is such that by the flap operation considerable saving of the limb may be effected.

If I am not greatly mistaken, the members of the medical department of the army were in favour of the circular method of operating in Mexico. Some of the best operators in our corps amputated in this manner; and one of them, who served in the field from Corpus Christi to the surrender of the city of Mexico, and who was an advocate of the flap operation, and practised it at the beginning of the war, informs me that he changed both his opinion and practice, on the ground that the stump made by the circular operation is the best. His name would be gladly given were I at liberty to do so, but it is to be hoped that he will give the results of his experience. Whatever may be the experience of others, my own opinion is decidedly in favour of the circular method.

In the *American Journal* for October, 1848, is a communication from Dr. M. G. Delany, Surgeon U. S. Navy, in relation to Mr. Syme's practice; and I am glad to see that the medical officers of the other arm of our service have taken the subject into consideration. And I must again be permitted to recommend Mr. Syme's able paper to the further notice of the profession, especially to military surgeons. Hereafter, if the country should be so unfortunate as to become involved in war, I shall be prepared to operate, *mostly*, by the "roundabout incision."

*Amputation at Joints.*—Amputation in the contiguity of limbs is much praised by several writers of high authority. Baron Larrey operated several times at the joints at the battles of Eslingen and Wagram, and “experience has since taught me,” says he, “that amputation at the joints in recent injuries is more successful, *ceteris paribus*, than amputation when performed in the middle or continuity of a limb.” \* \* \* \* “Finally, I do not hesitate to assert that nine of ten cases will succeed, where amputation has been performed at the joint; while two-thirds of the same number will scarcely survive, when the operation is performed in the continuity of the limb.” This is certainly strong language, by one of the most experienced military surgeons of the age. According to Larrey’s views, amputation at the hip-joint ought to be much more successful than the operation at the upper part of the thigh, and it may be, for aught I can prove to the contrary.

M. Sedillot says that—

“Amputation at the elbow-joint was adopted, and, if we may so speak, legalized by M. Dupuytren. It is declared by M. Velpeau to be less dangerous than amputation of the arm in its continuity, but M. Sedillot justly thinks that we are not as yet possessed of a sufficient number of facts to substantiate this statement, and prefers, in all cases, removal of the arm according to the common method.”—Dr. Nonius, in *Am. Journ.*, vol. xxi. p. 437.

It is fortunate that the ball-and-socket joints are so simple in their conformation, for it is often essential to the preservation of life that amputation should be performed at the hip and shoulder. The ginglymoid joints are more complicated, and are more liable to accidents than the others, but the necessity for the operation is not so imperious, and we have an election. Instead of amputating at the ankle-joint, we may operate just above; instead of the operation at the elbow, we may amputate just above or below the joint; and it will be a long time before I would undertake an operation at the knee, notwithstanding the authority of Larrey, Syme, Dupuytren, Velpeau, and other eminent surgeons.

Amputation, primary or secondary? This question has been, and continues to be, an important one in military surgery. It is well known that M. Faure, who was an advocate for delaying the operation, received the medal of the French Royal Academy of Surgery, after the battle of Fontenoy, for his essay on the prize question—“Is it advisable to amputate immediately after gunshot wounds, or should the operation be deferred?” Afterwards, Bilguer, surgeon-in-chief of the Prussian army, and Schnucker, his successor, held the same opinion. Subsequently, John Hunter, who, on military surgery, “led to bewilder, and dazzled to blind,” came upon the stage, and by his influence and authority extended the doctrine, in a great measure, to the present day. Among the moderns who have treated of gunshot wounds, M. Malgaigne and M. Gosselin, his colleague, and Mr. Rutherford Alcock, hold to the same opinions. For M. Malgaigne’s statistics, &c., see *Am. Journ.*, vol. xvi. p. 458, Oct. 1848. M. Malgaigne’s general conclusion is that, in “attempting to preserve the limbs of the wounded, the surgeon does not cause them to

incur any greater risks than if amputation were performed." The views of Mr. Alcock are well known to the profession.

But M. Faure gave a pretty large list of exceptions to his general rule; for, where a member has been carried away, an important articulation violently fractured—the bone of an extremity shattered, with extensive destruction of soft parts, or the bones have been minutely comminuted and surrounded by a considerable contusion of the soft parts, with laceration of the tendons and aponeurosis—where the structures of the large joints are torn, and the bones are fractured, and where the main artery is lacerated and the hemorrhage cannot be controlled, it would be dangerous, in M. Faure's opinion, to defer an operation.

Baron Larrey gives the following reasons for immediate amputation on the field of battle:—

"1. The inconvenience which attends the transportation of the wounded from the field of battle to the military hospitals on badly-constructed carriages; the jarring of the wagons, &c.

"2. The danger of remaining long in the hospitals. This risk is much diminished by amputation.

"3. In case the wounded are of necessity abandoned on the field of battle."

Larrey states that, in the terrible battle with the British fleet under Lord Howe, 1794, the chief surgeon of the *Jemmapes* amputated immediately, and was successful; while the surgeon of the *Temeraire* (taken by the English), by the advice of their surgeons, postponed the amputation of which many were in need, until they should arrive in port; but they all died on the passage.

"During the war in North America, in 1780, the surgeons of the French army performed a great number of amputations according to the prevailing opinion in France, that an operation should not be attempted until the primary symptoms have ceased. The Americans, on the contrary, who had the courage to amputate immediately, or within the first twenty-four hours, where their wounded required it, lost but a very small number: and yet, M. Dubor, then surgeon-major of the Artois dragoons, of whom I learned the fact, asserts that the condition of the hospital in which the wounded French were accommodated, was in many respects superior to that where the wounded Americans were placed."—*Memoirs*, vol. ii. p. 109.

Dr. Mann, Hospital Surgeon U. S. A., in the war of 1812 (*Medical Sketches*), adopting the opinions of Faure, Bilguer, and Hunter, was an advocate for delay. It is interesting to trace the apparent reasons. According to M. Dubor, the Americans were eminently successful in their operations in 1780; but they had been acquiring knowledge from 1775, at Bunker's Hill, and Long Island, in New Jersey, at Brandywine, Saratoga, &c., or they were poor scholars; and whatever their views might have been at the commencement of the war, notwithstanding the bad state of funds, and want of all things which seem essential, they succeeded much better than the French surgeons, who were influenced by the prize question, and the decision of the Royal Academy. But the French Revolution, and the tremendous wars on the continent of Europe, overturned all these notions. On the contrary, our surgeons had no experience in 1812. Our country had been in profound peace since

1783, and the dogmas of John Hunter had full sway. Hence (it is presumed) the opinions and practice of Dr. Mann, though other surgeons in our service at that time might not have been of the same opinion.

Mr. Guthrie on the same subject:—

“It is not sufficient to perform twenty amputations on the field of battle, and contrast them with as many cases of amputation done at a later period. The twenty cases for delayed operation must be selected on the field of battle, and their result compared at the end of three months with that of the others; when the value of the two modes will be duly estimated.”

Mr. Guthrie gives the following official statement of mortality:—

	Secondary.	Primary.
Upper extremities, . . . . .	12	to 1
Lower “ . . . . .	3	to 1

“Many had wounds will never reach this secondary stage, especially in the summer season; and, if the patients outlive the first symptoms, they will not outlive the operation.”—*Gunsiot Wounds*, p. 238.

The question is well stated in Drury's *Surgery*—

“It must be recollected that the question is, not whether a hundred men just wounded, and requiring amputation, are more likely to survive it than a hundred who have gone through the ordeal of six weeks in a hospital; but whether the first hundred would live to that period; which most probably they would not.”

Larrey says:—

“If Faure still has followers, I invite them to repair to the field of battle during an engagement. They will then soon be convinced that, without primitive amputation, a great number of the wounded must die. In Egypt, this truth was most completely demonstrated.”

Mr. Hennen says:—

“Finally, the results of the field amputations, after the battle of Waterloo, confirm the published experience of both these writers (Larrey and Guthrie), and it is to be hoped that the question is now set at rest forever.”

A year or two previous to the breaking out of the war with Mexico, I listened to a lecture on this subject from a professor of surgery in one of our medical schools; and he gave his opinion, that military surgeons were disposed to look with great favour on secondary amputations. His principal authority was Mr. Rutherford Alcock. This circumstance has induced me to devote more space to the question than would otherwise have been done. I venture to say that no rule was more universally acted upon by the surgeons of our army in Mexico, from the battle of Palo Alto to the treaty of peace, than the one laid down by Hennen: “With as little delay as possible.” In the words of Hennen: “While hundreds are waiting for the decision of the surgeon, he will never be at a loss to select individuals who can safely and advantageously bear to be operated on as quickly as himself and his assistants can offer their aid.” This was the decided practice of every medical officer with whom I served during the war. (See Hennen, pp. 55, 56, 57, 58; Guthrie, pp. 216-232.)

Certain wounds are received on the field of battle, in which it is difficult to

decide whether amputation is the proper practice, or not. If the operation be not performed, the patient will certainly die; but reaction never comes on. A private of the fifth infantry regiment was wounded at Monterey on the morning of the 21st of September, 1846, by a shell which struck the lower part of the thigh. The shock to the system was great, and reaction did not come on; but the patient suffering great pain, we determined to amputate, hoping that he would improve after the operation. Drs. Conrad, De Leon, and myself took off the limb at the upper part of the thigh; but the operation was of no avail, and the patient died that night. These are trying cases. The instance of Gen. Daboville, related by Larrey, affords some slight encouragement for the operation under these circumstances. Perhaps the best course would be—if nearly certain that death must take place, unless the operation be performed, and we can be tolerably sure the patient will live through it—to amputate: but it is a most important question. *Occasio preecepit, judicium difficile.*

*Dressing of the stump after amputation.*—Having alluded to sutures in the former paper, it may be well to briefly state the mode of dressing. Sutures were always employed; numerous enough to bring the edges of the wound into complete coaptation in the whole line of the incision, and adhesive straps were afterwards applied to assist the stitches by preventing too much weight from resting upon them. I have never known them produce so much irritation as to require removal before the proper period for the first dressing; and, by the time this is necessary, the wounded can be collected, and the hospitals formed, when such stitches as are not necessary may be removed. By this time, the wound may be united in its whole extent. Adhesive plaster, *per se*, was never relied upon. On no account was a stump dressed without stitches, and incised wounds of every kind were treated in the same manner. The cold water dressing, or lead water, may be employed, if considered necessary; but in very many cases nothing but perfect rest is required, with light covering to the wound, until the patient recovers. *I consider stitches absolutely necessary in military surgery, on account of the frequent removals to which the wounded are subjected during and after engagements, often in wagons of the roughest kind. Indeed, I am in favour of them in almost all circumstances, the scalp always being excepted.*

In regard to authority, Chelius is opposed to sutures; Mr. South thinks the surgeon may "use his own discretion;" Mr. Syme says they may be employed "if necessary;" and Mr. Liston gives the following opinion: "If such means (adhesive straps) be considered insufficient, recourse must be had to a few points of interrupted suture, and these are not productive of the bad consequences which have been by some attributed to them. When neatly applied, they can produce but little irritation, more especially if removed as soon as their presence is unnecessary; that is, as soon as adhesion has fairly commenced, and the natural bond of union is of such strength as to need no artificial assistance. By these the edges of the wound are more neatly and suitably placed than by any other; they meet easily, without the puckering or over-

lapping of each other; and from the circumstance of sutures obtaining a more just coaptation, they can be sooner discontinued. In most wounds, no other dressing is required; but in some a combination of sutures, adhesive plaster, and compress is necessary."

No one would, of course, pass stitches through the muscular substance.

The majority of French surgeons have always opposed union by the first intention. Even Larrey, during a career of more than half a century, always opposed it, but some of the modern French surgeons are in favour of the practice.

*Anæsthetic Agents in Operations for Gunshot Wounds.*—In our former paper, the case of Williamson was presented with some remarks in relation to the use of sulphuric ether for producing anaesthesia in operations in the General Hospital at Vera Cruz, in 1847. In the summer of that year, an amputation of the thigh was performed, the patient having been put under the influence of ether, in which the hemorrhage was almost uncontrollable. The blood spouted in all directions, and I have never seen an operation where it was necessary to secure so many bleeding vessels. Even after every small vessel that could be got at was secured, it was necessary to use cold water freely to suppress the general oozing of blood. At the time, I imputed the obstinate hemorrhage to the pernicious influence of the ether. In gunshot wounds anaesthetic agents are almost universally unnecessary, and are almost universally injurious. It was for this reason that they were entirely given up in the hospital at Vera Cruz.

It may be well questioned whether anaesthetics are not calculated to produce injurious effects in all important amputations; but they certainly do so in operations performed for gunshot wounds. M. Velpeau says: "Chloroform evidently depresses the nervous system, and as great prostration always exists in patients who have received gunshot wounds, it is advisable to refrain from any anaesthetic means."—*Ranking's Abstract*, 1848. Mr. Alcock refers to the cases of soldiers wounded in battle, where the excitement is such as to carry them through almost any operation. I regret that Mr. Alcock's paper is not before me. These are the cases spoken of by Mr. Guthrie: "Soldiers in general are anxious to undergo an operation when they find it inevitable, and frequently press it before the proper time; that is, before they have sufficiently recovered the shock of the injury."—*Gunshot Wounds*, p. 232. These are the cases which require a little more time, some "encouraging words," and perhaps a little wine or brandy and water; but no anaesthetics, for the patients are already sufficiently depressed.

There are two sets of cases; in the one (Velpeau's), the shock to the nervous system is great, from which the patient may not recover, and the use of anaesthetics would be awfully destructive; in the other class, they are unnecessary, and would prove useless and injurious. In the flap operation, they must

prove more injurious than in the circular; from the fact that muscle forms almost the entire covering for the stump; and the contractility of the muscular tissue is for a time almost annihilated, to be recovered irregularly at irregular intervals. Further, after the use of these agents wounds do not heal so readily by the first intention.

M. Jobert, on the use of ether, states that the local inflammation has proved less, and that union by the first intention has been prevented. I am able to bear testimony to the correctness of M. Jobert's statement.

I must be permitted to refer to the *Transactions of the American Medical Association* for 1851, pp. 271, 272, 315, 323. In the Massachusetts General Hospital:—

"It does not appear that the fatal results of amputation have at all diminished by the introduction of anesthetic agents."

New York Hospital:—

"The general mortality has been for three years and a quarter forty *per centum*. As regards the method of operating, we observe that the amputations of the thigh, in which the fatality was as high as thirteen in seventeen, were all flap operations. Eleven of the leg were removed by the circular, one died; while of four by the flap, two died."

That is, nine *per cent.* in one set of cases, and fifty *per cent.* in the other.

"In almost every case chloroform or ether was employed; but, while it is admitted that anesthetics may have had some influence in the increased mortality in the New York Hospital over preceding years, since union by the first intention was now much less frequently observed; still it is to be remembered that hospital gangrene, entirely unknown before, and purulent cachexia and erysipelas extensively prevailed there during the past three years."

Could the anesthetics have had an influence in producing the "hospital gangrene, entirely unknown before," and the "purulent cachexia and erysipelas," as well as prevent union by the first intention?

Dr. Leute, Resident Surgeon of the New York Hospital, says:—

"In almost every case, however, either chloroform or ether was employed; generally the former until the occurrence of a fatal case from it in this hospital; afterwards the latter, from which we have never had any bad consequences, and which has never failed to prove effectual. \* \* \* Anesthetics came into general use about the period of the commencement of these statistics. May not the employment of these have had its influence upon the mortality? This is a very important question. We do not deny that it may have had some influence in augmenting the fatality of operations; but we have seen no reason to infer that it has, except perhaps the fact that *union by adhesion* seems to have been much less frequent since the introduction of anesthetics into this hospital than before. Whether the two are in the relation of cause and effect, it is, we fear, impossible to determine at present."

In an unhealthy atmosphere or climate, the healing of wounds by adhesive union is doubly important for obvious reasons; and I have often regretted that etherization was so much resorted to in capital operations at Vera Cruz during a portion of 1847; nor can I avoid congratulating both the patients and myself that, before the summer had passed away, its employment was wholly abandoned. Anesthetics poison the blood and depress the nervous system; and, in consequence, hemorrhage is much more apt to occur, and union by adhesion is prevented.